

APPLICANT:

Randhir P. Thakur et al.

Patent & Trademark Office

HIGH PRESSURE ANNEALS OF INTEGRATED CIRCUIT STRUCTURES

Docket No.: 303.275US2

Serial No.: 09/761355

Filed: January 16, 2001

Due Date: May 6, 2004

Examiner: Richard Booth

Group Art Unit: 2812

MS Appeal Brief-Patents

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

- ☒ A return postcard.
- ☒ Appellants' Brief on Appeal (in triplicate) (16 Pages).
- ☒ Petition for Extension of Time (1 pg.)
- ☒ Permission to charge Deposit Account No. 19-0743 in amount of \$330.00 to cover the fee required to file an Appeal Brief.
- ☒ Permission to charge Deposit Account No. 19-0743 in the amount of \$420.00 to cover the Extension of Time Fee.

Please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.

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SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.

(GENERAL)



09/761,355

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Randhir P. Thakur et al.

Serial No.:

09/751,355

Filed:

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For:

HIGH PRESSURE
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APPELLANTS' BRIEF ON APPEAL**Mail Stop Appeal Brief-Patents**

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Sir:

This Appeal Brief is presented in support of the Notice of Appeal to the Board of Patent Appeals and Interferences, filed on January 6, 2004, from the Rejection of claims 79-99 of the above-identified application, as set forth in the Final Office Action mailed August 6, 2003.

This Appeal Brief is filed in triplicate and accompanied by an authorization to charge the requisite fee set forth in 37 C.F.R. § 117(f) and any extension of time fee to Appellants' deposit account 19-0743. Applicants respectfully request reversal of the Examiner's rejection of pending claims

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APPELLANTS' BRIEF ON APPEAL

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1. REAL PARTY IN INTEREST

The real party in interest of the above-captioned patent application is the assignee, Micron Technology, Inc., a Delaware corporation doing business at 8000 South Federal Way, P.O. Box 6, Boise, Idaho 83707-0006.

2. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to the Appellant that will have a bearing on the Board's decision in the present appeal.

3. STATUS OF THE CLAIMS

Claims 79 – 99 are pending and the subject of the present appeal (see Appendix I). No other claims remain in the application.

All of the claims are also subject to an obviousness double patenting rejection which Appellants do not dispute, other than observing that submission of a Terminal Disclaimer would be premature at this time, until the exact wording of the claims to be allowed is established. Once claims are allowed a Terminal Disclaimer will be filed.

4. STATUS OF AMENDMENTS

This application was originally filed on January 16, 2001, with claims 42-43, 48 and 59 pending after entry of the Preliminary Amendment filed with the application which is a division of U.S. Serial Number 08/790,279 filed January 28, 1997 which issued January 16, 2001 as U.S. Patent 6,174,806.

Amendment and Response to Office Action filed July 26, 2002.

Amendment and Response to Final Office Action filed January 8, 2003 with RCE.

Amendment and Response to Office Action filed May 5, 2003.

Final Office Action after RCE was mailed August 6, 2003.

Amendment and Response to Final Office Action was filed October 31, 2003.

Advisory Action was mailed November 24, 2003.

A Notice of Appeal was filed on January 6, 2004.

5. SUMMARY OF THE INVENTION

The claims relate to a method for forming an interconnect in a contact hole defined by walls of an insulating material and a supporting substrate. The method includes depositing titanium on the supporting substrate at the bottom of the contact hole; depositing a titanium nitride layer on the walls of the contact hole and the supporting substrate; annealing the supporting substrate to form titanium silicide between the supporting substrate and the titanium nitride layer; filling the contact hole with a conductive material deposited on the titanium nitride layer by a CVD process, utilizing a pressure of at least approximately 1.1 atmospheres; and forming a metal line on the conductive material over the contact hole .

6. ISSUES PRESENTED FOR REVIEW

Did the Examiner satisfy his burden to set forth a *prima facie* case of obviousness under 35 U.S.C. § 103?

7. GROUPING OF CLAIMS

The claims do not stand or fall together. Appellant suggests the following groups of claims which are in accord with the grouping of the claims established by the Examiner. Within each group, each claim does stand or fall with the other claims in that group and any dependent claims to those claims; each group being argued separately below.

Group I: 79 - 86 and 90 - 99

Group II: 87 - 89

Appellant does not make any admission that any claim may not be argued in another forum as independently patentable from any other claim.

8. ARGUMENT

The Applicable Law

"A patent may not be obtained...if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art." 35 U.S.C. § 103(a).

The Examiner has the burden under 35 U.S.C. § 103 to establish a *prima facie* case of obviousness. *In re Fine*, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). To do that he must show that some objective teaching in the prior art or some knowledge generally available to one of ordinary skill in the art would lead an individual to combine the relevant teaching of the references. *Id.*

The *Fine* court stated that:

Obviousness is tested by "what the combined teaching of the references would have suggested to those of ordinary skill in the art." *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 878 (CCPA 1981)). But it "cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination." *ACS Hosp. Sys.*, 732 F.2d at 1577, 221 USPQ at 933. And "teachings of references can be combined *only* if there is some suggestion or incentive to do so." *Id.* (emphasis in original).

Consider the requirements set forth in the Manual of Patent Examining Procedure to establish *prima facie* obviousness.

MPEP §2142

"The legal concept of *prima facie* obviousness is a procedural tool of examination which applies broadly to all arts. It allocates who has the burden of going forward with the production of evidence in each step of the examination process. See *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); *In re Lintner*, 458 F.2d 1013, 173 USPQ 560 (CCPA 1972); *In re Saunders*, 444 F.2d 599, 170 USPQ 213 (CCPA 1971); *In re Tiffin*, 443 F.2d 394, 170 USPQ 88 (CCPA 1971), amended, 448 F.2d 791, 171 USPQ 294 (CCPA 1971); *In re Warner*, 379 F.2d 1011, 154 USPQ 173 (CCPA 1967), cert denied, 389 U.S. 1057 (1968). The Examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. If the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness. If, however the examiner does produce a *prima facie* case, the burden of going forward with the evidence or arguments shifts to the applicant who may submit additional evidence of

The rejections at issue:

1. Claims 79-86 and 90-99 were rejected under 35 USC § 103(a) as being unpatentable over Wolf in view of Chu (U.S. 5,783,471) and further in view of Dobson (U.S. 5,527,561) and Chittipeddi et al. (U.S. 5,147,820) and Cheng et al. (U.S. 5,891,805).
2. Claims 87-89 were rejected under 35 USC § 103(a) as being unpatentable over Wolf in view of Chu (U.S. 5,783,471) and further in view of Dobson (U.S. 5,527,561) and Chittipeddi et al. (U.S. 5,147,820) and Cheng et al. (U.S. 5,891,805) as applied to claims 79-86 and 90-99 above, and further in view of Gardner et al. (U.S. 5,679,585).

The first rejection (claims 79-86 and 90-99) repeats a combination of Wolf, Chu and Dobson that was first set forth in the Office Action of February 4, 2003 (pages 5-6). Additionally, Chittipeddi and Cheng et al were added to the rejection in the Office Action of August 6, 2003 (page 6) in response to Appellants' challenge (Amendment and Response of May 5, 2003, page 9) to the first rejection as its taking of "official notice."

The second rejection (claims 87-89) merely adds Gardner et al to the five patents which now comprise the first rejection.

Appellants respectfully submit that the Examiner did not make out a *prima facie* case of obviousness because he failed to show evidence of a suggestion or motivation to combine the patents as his Office Action proposed (OA of 2/4/2003 pages 5-7; FOA of 8/6/2003 pages 3-6) .

The Examiner relied upon the cited Wolf patent as showing "Al-TiN-Ti-Si contacts," contending that Wolf shows forming the contacts by depositing a layer of Ti, followed by forming titanium nitride over the Ti, annealing to react the titanium with the substrate and form titanium silicide; and forming an overlying aluminum or tungsten layer (OA 2/3/2003 page 5; FOA 8/6/2003 page 3).

Concluding that Wolf did not show an annealing operation as called for in the claims, the Examiner initially (OA of 2/4/2003, page 5) took "official notice" that "annealing to form the silicide layer in an inert or nitrogen ambient and the particular aspect ratio of the trench" is "well known in the art to be used to prevent contamination of the device structure and that the claimed aspect ration was commonly used at the time the invention was made". Appellants duly traversed that taking of "official notice" (Amendment and Response 5/9/2003, page 9) and requested the

nonobviousness, such as comparative test data showing that the claimed invention possesses improved properties not expected by the prior art. The initial evaluation of prima facie obviousness thus relieves both the examiner and the applicant from evaluating evidence beyond the prior art and the evidence in the specification as filed until the art has been shown to suggest the claimed invention. (emphasis added)

.....

The initial burden is on the examiner to provide some suggestion of the desirability of doing what the inventor has done. 'To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention or the examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references.' *Ex parte Clapp*, 227 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985). (emphasis added)

MPEP §2143

"To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all of the claimed limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. *In re Vaack*, 947 F.2d 488, 20 USPQ2d 1438 (fed. Cir. 1991)"

In the relatively recent case of *In re Lee*, 61 USPQ2d 1430 (Fed. Cir. 2002), reiterated the prior cases and specifically required that

"When patentability turns on the question of obviousness, the search for and analysis of the prior art includes evidence relevant to the finding of whether there is a teaching motivation or suggestion to select and combine the references relied on as evidence of obviousness" 61 USPQ2d at 1433.

The Federal Circuit in *In re Lee* also indicated that the "factual question of motivation is material to patentability, and could not be resolved on subjective belief and unknown authority." 61 USPQ2d at 1434.

Argument

A. The Examiner failed to make out a *prima facie* case of obviousness in rejecting claims 79 – 86 and 90 - 99 under 35 U.S.C. § 103(a).

Examiner to provide a reference supporting the allegation concerning annealing.

After Appellants traversed this taking of "official notice," the Examiner cited the Chittipedi et al patent, contending it describes "forming a silicide film through an anneal in a nitrogen atmosphere." (FOA, Page 5) Cheng et al was also cited as disclosing "...that it is desirable to form contact holes with an aspect ratio of greater than 2:1 (citing col. 2, lines 6-13 of that patent). (FOA, page 5)

No evidence of a teaching or suggestion to combine the Wolf, Chu, Chittipedi and Cheng patents has ever been pointed to in any Office Action. In fact, the only reasons ever stated by the Examiner to show that there is of a suggestion or motivation to combine the patents are clearly mere conclusions based on a hindsight view of the cited patents through the lens of Appellants claimed invention:

"In view of there disclosures, it would have been obvious to one of ordinary skill in the art at the time that the invention was made to modify the process of Wolf modified by Chu and Dobson (and presumably Chittipedi et al and Cheng et al) so as to form a silicide by anneal in a nitrogen atmosphere and to form a contact hole with an aspect ration of greater than 2:1 because high aspect ratio contact holes are desirable in semiconductor processing and annealing in an inert atmosphere such as nitrogen to form a silicide is a suitable method to form a contamination free silicide film. (FOA, page 5)"

Whatever the additional patents to Chittipendi and Cheng may be contended to show, the Examiner has continually failed to point to any evidence in one of the cited patents or elsewhere that one of ordinary skill in the art at the time that the invention was made would have provided a suggestion or motivation to combine Chittipedi and Cheng et al in the manner proposed in the Office Actions. *In re Lee, supra*, requires such evidence to be provided. The failure to provide such evidence of a motivation or suggestion to combine elements asserted to be present in Wolf, Chu, Dobson, Chittipeddi and Cheng et al demonstrates that both obviousness rejections are defective since they fails to meet the requirements prerequisite to establish a *prima facie* case of obviousness.

What has the Examiner said on the critical point as to providing evidence of a motivation to combine teachings of multiple publications? The Examiner conceded that Wolf "fails to expressly disclose forming a metal line on the conductive material over the contact hole and

forming the aluminum or tungsten layer by a CVD process using a pressure of at least 1.1 atmospheres." (FOA, page 4) The Examiner looked to the cited Chu patent, characterizing it as relating to the "forming of a metal line overlying a conductive interconnection structure." (FOA, page 4) Rather than providing evidence of a teaching suggestion or motivation to combine, the Examiner merely claimed that it would have been obvious to one skilled in the art to modify Wolf as suggested by Chu "because this would allow for communication with other active regions in a memory array." (FOA, page 4)

Applicant respectfully notes that the Examiner has nowhere pointed to any evidence which provides a suggestion or motivation to combine prior art teachings as the Office Actions have proposed. The Examiner has still not provided a rationale for how one could modify Wolf by turning to Chu. Note that Chu purports to show formation of conductive plugs 313 in contact holes and then forming a conductive layer over the plugs and etching the layer to form traces 316 and 317. There is nothing pointed to by the Examiner in either Chu or Wolf which shows or suggests using the conductive plugs as allegedly shown in Chu with the contact structure as purportedly shown in Wolf.

The Examiner also cited Dobson as showing the forming of a metal layer in a hole and then subjecting the structure to an elevated temperature and pressure (greater than 3000 psi) to form a via. (FOA, page 4) The Examiner conceded that Dobson does not show force filling at a "pressure greater than 1.1 atmospheres." (FOA, page 4) The Office Action contended that it would be obvious to force-fill the conductive layer in Wolf "because this allows for the void free filling of high aspect ratio vias." (FOA, pages 4-5) The Examiner has not shown that Wolf shows high aspect ratio vias and the Examiner has pointed out nothing in Dobson suggesting the applicability of its processes to the Al-TiN-Ti-Si contacts of Wolf.

In addition to not responding to the deficiencies of Dobson as a reference that were pointed out by Appellants, the Examiner has not pointed to evidence of a teaching anywhere which would provide a suggestion or motivation to combine any Wolf and Dobson teachings as proposed. The Examiner has continually failed to provide a rationale showing a teaching, motivation or suggestion to modify Wolf by turning to Dobson.

None of the Office Actions in the present application state a *prima facie* case of obviousness because of their failure to provide evidence of a teaching or suggestion to combine aspects of the Wolf, Chu, Dobson, Chittipedi and Cheng (and Gardner) patents as the Examiner proposed in the rejections of record.

B. The Examiner was Mistaken in Stating that Applicant had a burden of overcoming an unproven case of obviousness

In the "Response to Arguments" at page 8 of the Office Action the Examiner responded to Applicant's prior challenge as to the lack of evidence of motivation or suggestion to combine, stating:

"In this case, a *prima facie* case of obviousness has been established by the above rejections and an effective rebuttal to overcome the *prima facie* case of obviousness has not been provided. (sentence bridging pages 6 and 7)"

Clearly the Office Action has mistaken where the burden lies in this case.

Notwithstanding the Examiner's conclusory statement, there has been no evidence presented in the Office Action showing a motivation or suggestion to combine the five (or six) separate patents cited.

The failure to provide that sort of showing means that the Examiner has failed to meet the burden of establishing a *prima facie* case of obviousness. Since the Examiner has not made out a *prima facie* case of obviousness, the burden has never shifted to Applicant to demonstrate non-obviousness.

Appellants not sought to offer rebuttal evidence and has no duty to do so since the Examiner has failed to meet the burden of proving a *prima facie* case of obviousness.

C. Conclusion

Both rejections which are at the heart of this appeal are defective since the Examiner has not shown a motivation for combining the various elements taken from five or six patents relied upon to support the rejection.

Reconsideration and withdrawal of the rejection and allowance of pending claims 79-99 is

respectfully requested.

9. SUMMARY

For the foregoing reasons, the Appellants respectfully submit that the rejections of claims 79 - 99 under 35 U.S.C. § 103(a) were erroneous. Reversal of those rejections and allowance of all of the claims is respectfully requested.

Please charge Deposit Account 19-0743 to cover the fee required to file the Brief..

Respectfully submitted,

Randhir Thakur et al

By their Representatives,

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Date May 6, 2004

By Charles E. Steffey
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Name Amy Moriarty

Signature [Signature]



APPENDIX

The Claims on Appeal

1. – 78. (Canceled)

79. (Previously Presented) A method for forming an interconnect in a contact hole defined by walls of an insulating material and a supporting substrate, comprising the steps of:

depositing titanium on the supporting substrate at the bottom of the contact hole;

depositing a titanium nitride layer on the walls of the contact hole and the supporting substrate;

annealing the supporting substrate to form titanium silicide between the supporting substrate and the titanium nitride layer;

filling the contact hole with a conductive material deposited on the titanium nitride layer by a CVD process, utilizing a pressure of at least approximately 1.1 atmospheres; and

forming a metal line on the conductive material over the contact hole.

80. (Previously Presented) The method of claim 79, wherein the contact hole has an aspect ratio of at least 2:1.

81. (Previously Presented) A method for forming an interconnect in a contact hole defined by walls of an insulating material and a supporting substrate, comprising the steps of:

depositing titanium on the supporting substrate;

annealing the supporting substrate;

filling the contact hole with a conductive material by a CVD process, utilizing a pressure of at least approximately 1.1 atmospheres the depth of the contact hole being at least twice the diameter of the contact hole ; and

forming a metal line on the conductive material over the contact hole.

82. (Previously Presented) The method of claim 81, wherein the contact hole has an aspect ratio of at least 2:1.
83. (Previously Presented) The method of claim 81, wherein the annealing step comprises annealing in a processing chamber having an inert gas ambient.
84. (Previously Presented) The method of claim 81, wherein the annealing step comprises annealing in a processing chamber having a nitrogen-containing ambient.
85. (Previously Presented) The method of claim 81, wherein the conductive material comprises aluminum.
86. (Previously Presented) The method of claim 81, wherein the conductive material comprises tungsten.
87. (Previously Presented) A method for forming an interconnect on the bottom of a contact hole in a supporting substrate comprising silicon, comprising the steps of:
 depositing titanium on the bottom of the contact hole in the supporting substrate to a thickness of approximately 500 to 2000 angstroms; and
 annealing the supporting substrate in a processing chamber at a pressure of at least approximately 1.1 atmospheres and a temperature of less than approximately 700 degrees Celsius to form titanium silicide directly on the supporting substrate; and
 filling the contact hole with a conductive material deposited on the titanium nitride layer by a CVD process, utilizing a pressure of at least approximately 1.1 atmospheres.
88. (Previously Presented) The method of claim 87, wherein the processing chamber contains an inert gas ambient.

89. (Previously Presented) The method of claim 87, wherein the processing chamber contains a nitrogen-containing ambient.

90. (Previously Presented) A method for forming an interconnect in a contact hole defined by walls of an insulating material and a supporting substrate, comprising the steps of:

depositing titanium on the supporting substrate at the bottom of a contact hole;

depositing a titanium nitride layer on the walls of the contact hole and the supporting substrate;

annealing the supporting substrate to form titanium silicide between the supporting substrate and the titanium nitride layer;

forming a tungsten plug in the contact hole directly on the titanium nitride layer by a CVD process at a pressure of at least approximately 1.1 atmospheres; and

forming a metal line on the tungsten plug over the contact hole.

91. (Previously Presented) The method of claim 90, wherein the contact hole has an aspect ratio of at least 2:1.

92. (Previously Presented) The method of claim 90, wherein the titanium is deposited to a thickness of approximately 500 to 2,000 angstroms.

93. (Previously Presented) The method of claim 90, wherein the titanium nitride is deposited to a thickness of approximately 30 to 300 angstroms.

94. (Previously Presented) The method of claim 90, wherein the processing chamber contains an inert gas ambient.

95. (Previously Presented) The method of claim 90, wherein the annealing step is performed at a temperature of less than approximately 700 degrees Celsius.

96. (Previously Presented) The method of claim 90, wherein the tungsten plug is formed by depositing tungsten and force-filling the deposited tungsten into the contact hole at a pressure of at least approximately 1.1 atmospheres.

97. (Previously Presented) The method of claim 90, wherein the tungsten plug is formed by depositing tungsten using chemical vapor deposition at a pressure of at least approximately 1.1 atmospheres.

98. (Previously Presented) The method of claim 90, wherein the metal line comprises aluminum.

99. (Previously Presented) The method of claim 90, wherein the metal line has a thickness of approximately 2,000 to 5,000 angstroms.

APPENDIX II

Cited Statutes, Rules, and Case law

I. Statutes and Rules

- 35 U.S.C. § 103(a)

II. Case law

- *Graham v. John Deere Co.*, 148 USPQ 459, 467 (1966).
- *Winner International Royalty Corp. v. Wang*, 53 USPQ2d 1580, 1586 (Fed. Cir. 2000).
- *Panduit Corp. v. Dennison Mfg. Co.*, 1 USPQ2d 1593, 1597 (Fed. Cir. 1987).
- *In re Fritch*, 23 USPQ2d 1780, 1784 (Fed. Cir. 1992).
- *In re Bond*, 15 USPQ2d 1566, 1568 (Fed. Cir. 1990).
- *In re Dembiczak*, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999).
- *In re Vaeck*, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991).
- *In re Lee*, 61 USPQ2d 143 (Fed Cir. 2002)